Dick Criley statistican at work in the MG office.

1964 Olympic Gymnastic
MEANS-MODES-MEDIANS

by Dick Criley

The 1964 Olympics furnished abundant material for the statistician. The statistics are not worth much unless they are put to use. Uses which can be envisaged include evaluation of individual and team performances in light of international competition, "ideal" methods of team selection, and prediction based on performance.

Many of our readers are aware of the ease with which statistics can be manipulated to suit a purpose. Thus, we find such terms as "mean", "mode", and "median". A mean is an arithmetic average of a collection of numbers. A mode, or modal class, is that figure which occurs with greatest frequency in the population of numbers. It may be either higher or lower than the mean or the same. A median is that value for which, when all the numbers are ranked in order of magnitude, 50% of the numbers lie on each side. For examples let us look at Table 1.

Considering the scores of the 130 competitors in floor exercise (see the January issue of the Modern Gymnast), one could be quite misled about the caliber of competition if he knew only the mean score, 17.63. However, a clearer picture would be gained when it is seen that 50% of the competition scored above 18.20. Two modes would have been considered as 6 performers received a score of 18.45 and 6 received 18.35. These scores shared the distinction of being most frequent.

How can this information be useful? What interpretatitons can be made? For those who engage in "What might have been," a score for a better executed exercise may be imagined to place the exercise in a more favorable light of competition. Or statements such as "all of our gymnasts performed above the average score in X event" can be considered critically if it is realized that some of the performances still ranked in the lower half of competitive efforts. It is obvious in the reflection of the average and median scores that individuals having a score lower than the average were considerably lower and that the caliber of competition was often considerably better than the average would indicate.

A logical extension of these thoughts leads one to ask what scores would have been necessary to qualify for the top 20 all-around positions. Again, Table 1 supplies the answers .But the interesting comparison lies in comparing the mean score of the top 20 all-around performers with that of the top 20 performers in each event. This is probably a good place to re-emphasize that more considerations entered the picture than the score alone indicated. To mention a few, we would list personalities, politics, and time of competition.

But what was necessary to earn a place among the finalists for medal competition? In nearly all events a minimum compulsory score of 9.60 and a minimum optional score of 9.70 were needed to make the cutoff point, Table 1. However, once the finals were attained, the mean final scores were slightly lower, perhaps reflecting more critical judging.

Just so much can be made of these measures of central tendency, as the means, modes, and medians are called. The dispersion of scores also reveals something about the character of an event. The side horse has long been accorded the distinction of the most difficult event and the long horse vault has been recognized as providing the best opportunity for a high score. The bar diagrams of Figure 1 confirm these suspicions and, along with the figures of Table 1, provide a basis for assessing the difficulty of the other events in this field of top-flight international competition. Only 4.6% scored 19.00 or above in the side horse competition but 22.3% scored 19.00 or better on long horse. On still rings over 50% failed to score as well as 18.00 but only 13% failed to do this well in vaulting. The reader is encouraged to develop this device for evaluation even further.

The top 20 scores of each event were plotted on graph paper to see if a sudden drop occurred. Parallel bars and the horizontal bar scores displayed a drop of .15 between fourth and fifth positions, but these were the only noticeable instances. A single straight line was drawn to represent as closely as possible the trend of the top 20 scores of an event. Figure 2 represents a compilation of the 6 lines for the 6 events *for the top 20 positions only.* Besides indicating the similarities between parallel bars, horizontal bar, floor exercise, and still rings, and the strong deviations of side horse and long horse, this figure has another interesting use, the prediction of position or score given either.

Thus, if a predicted mean score or the 10th performer is desired for each event, a perpendicular line is raised from the bottom of the graph through the lines representing the events and a reading is made on the left with the resulting accuracy as presented in Table 2. Similarly if the mean score of a performer were 19.06 (the calculated mean score for 6 events for the "average gymnast" in the top 20 all-around performers), the final placing of this score is read on the bottom scale, Table 2. Such a chart could be presented for any level of competition and is useful as a prediction tool within the range of the chart. It is also true that the chart is more accurate in its middle values than at extremes (long horse vault for example). A score or ranking outside that of the table is not likely to be located validly by extending the lines because the slope of the line will change as more values are added to it.

Table 1. Presentation of means, medians, and modes by event for the Olympic gymnastics scores of all competitors, the top 20 all-around performers, the top 20 finishers in each event, and the final six competitors in each event.

	Floor Exercise	Side Horse	Still Rings	Long Horse Vault	Parallel Bars	Horizontal Bar	All-around
All Competitors							
Mean	17.63	17.24	17.48	18.39	17.93	17.51	104.97
Median	18.20	18.15	17.90	18.75	18.50	18.75	109.25
Mode	18.45 (6)	18.55 (8)	17.50 (6)	18.75 (15)	18.80 (10)	18.25	110.65 (3)
	18.35						104.30
Top 20 all-around							
Mean Score							
Comp.	9.472	9.430	9.485	9.555	9.600	9.572	57.11
Opt.	9.497	9.415	9.550	9.615	9.565	9.577	57.23
Total	18.969	18.845	19.935	19.170	19.165	19.149	114.34
Place	13	10	13	15	10	11	13
Top 20 in event							
Mean Score							
Comp.	9.052	9.457	9.527	9.590	9.605	9.562	
Opt.	9.567	9.440	9.590	9.657	9.610	9.568	
Total	19.069	18.897	19.117	19.247	19.215	19.130	
Place	11	7	9	9	9	11	
Medal winners							
Mean Score							
Comp.	9.592	9.575	9.708	9.691	9.733	9.675	
Opt.	9.675	9.641	9.700	9.708	9.716	9.725	
COA	9.633	9.608	9.704	9.700	9.725	9.700	
Final	9.583	9.508	9.658	9.587	9.500	9.641	
Total	19.216	19.116	19.362	19.287	19.225	19.341	

The figures in parentheses behind modal scores indicate the number of times that score occurred.

COA—Compulsory and optional average.
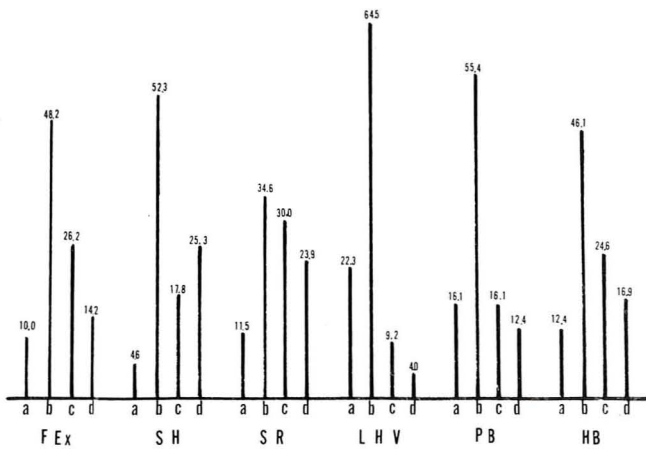
ABOVE FIGURE 1. Relative frequency (percent) of score distribution by event for men's Olympic gymnastics. a. percent scores including and exceeding 19.00, b. percent scores falling between 18.00 and 18.99, c. percent scores falling between 17.00 and 17.99, d. percent scores less than 16.99.

BELOW FIGURE 2. Graphical representation of the top twenty scores in each of the six Olympic events, based on the 1964 Olympics.
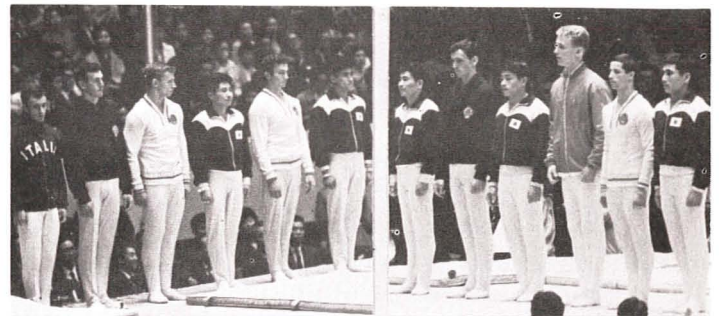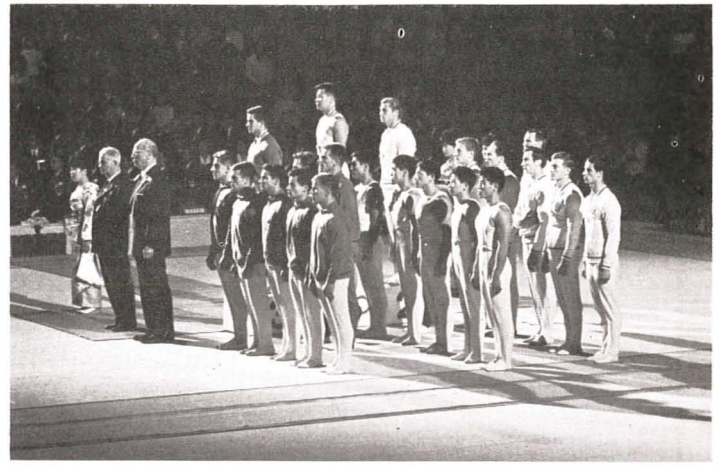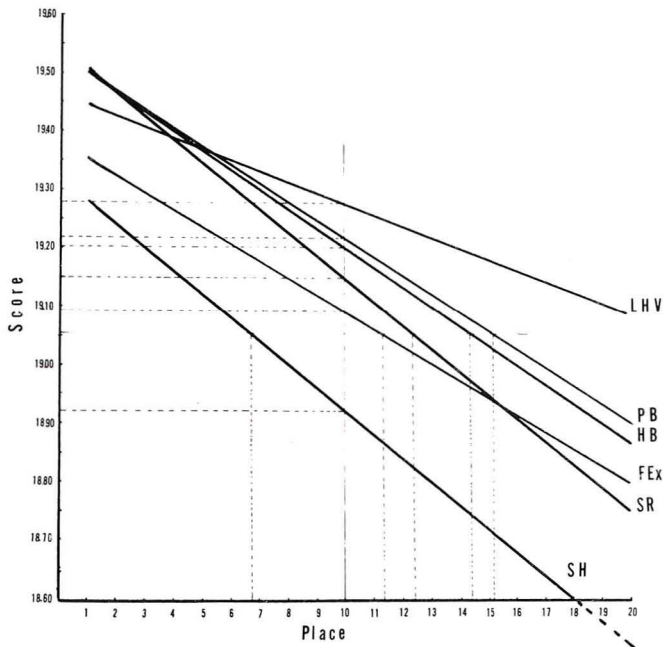

Table 2. Calculated and actual scores and rankings given a theoretical rank or score and Figure 1. Differences are not significant as determined by Chi-square test.

Event	Score for tenth rank		Rank for mean score of 19.06	
	Calc.	Actual	Calc.	Actual
Floor Exercise	19.09	19.10	11	11
Side Horse	18.92	18.85	7	6
Still Rings	19.15	19.10	12	12
Long Horse	19.28	19.25	21	24
Parallel Bars	19.22	19.15	15	14
Horizontal Bar	19.20	19.20	14	14

Similar statistics and figures can be derived for the women competitors from the scores presented in the January Modern Gymnast.

(Next: the evaluatiton of team and individual effort).

At Right and Above: Scenes from the Olympic Games team championships, All-Around champs, Event finalists and Competition site.